IMPROVING RELATIONS WITH HIGH TECH INDUSTRY EMERGENCY RESPONSE TEAMS

STRATEGIC MANAGEMENT OF CHANGE

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ABSTRACT

The problem was that the Austin Fire Department (AFD) had been unable to appease local high tech industry regarding a desire to reduce hazmat team responses to their sites. The purpose of this study was to evaluate a change in the way AFD coordinated with high tech industry emergency response teams (ERT), sponsors, leaders, and members. The research method used for this study was the evaluative research method.

There were two research questions to be answered in this paper. How was a change made in coordinating with high tech industry hazmat teams? How successful was the change? These were answered by using the Change Management Model (CMM) taught in the National Fire Academy course, Strategic Management of Change. The first three phases of the change model were compared to the actual change in order to both describe it and evaluate its completeness. The fourth and final phase of the change model was used to evaluate the success of the change by providing data that evaluated AFD hazmat team responses to high tech industry sites. An informal survey of high tech emergency response team members was conducted in order to determine if revisions to the change were warranted. The need to institutionalize this change was shown by providing data that might indicate whether the need might increase.

The results of this study were that AFD anticipated many of the change items included in the first three phases of the CMM, but did not identify the need to have a cooperative industry group representing the ERT responders. Results from the final phase indicated that AFD responses to high tech locations were decreasing. The informal survey indicated positive responses from ERT personnel concerning the change. The need to continue evaluating the change was determined by an increasing trend in the number of high tech industry sites in Austin.

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INTRODUCTION

The nature of the problem studied in this research paper is related to the inability of the Austin Fire Department (AFD) to appease local high tech industry regarding a desire to reduce hazmat team responses to their sites.

The purpose of this applied research project is to evaluate a change in the way the Austin Fire Department coordinates with high tech industry emergency response teams (ERT), corporate sponsors, leaders, and members.

The research method used for this study is an evaluative research method that follows the Change Management Model (CMM) presented in the National Fire Academy course, Strategic Management of Change.

There are two research questions to be answered by this research project. First, how were changes made in coordinating with high tech industry hazmat teams? Second, how successful were the changes? It is the intent of this research study to answer these questions utilizing the four phases of the CMM.

BACKGROUND AND SIGNIFICANCE

The number of local high tech industry sites that the Austin Fire Department (AFD) protects has grown steadily since 1967, when IBM was the first to locate in Austin, Texas. The new "Silicon Hills" of Texas gained national attention in 1983 when it was chosen as the location for the government sponsored Micro Computer Consortium. This selection was won over several cities in the more established "Silicon Valley" of California. The attraction of "clean industry" that utilized various

production chemicals resulted in the implementation of AFD's hazmat team in 1983. It also resulted in some bad press by 1986.

In October of 1986, Advanced Micro Devices, Inc. (AMD) experienced a fire in a pyrophoric gas exhaust duct. The resulting fire alarms caused the evacuation of 125 employees from its semiconductor fabrication plant, but no call to 911 was made from the on-site monitoring station. An OSHA investigation was prompted by employee complaints about inadequate alarms and evacuation procedures. AFD found out about the alarm and the OSHA investigation, when the local newspaper requested information, almost 10 months after the incident. The Austin American-Statesman described the OSHA report that included a quote from an unidentified AMD official who reportedly said that the company, "had more pressing items that had a higher priority than training employees on how to respond to an emergency." AMD officials responding to inquiries from AFD indicated that they considered the fire to be a minor incident that was controlled by their fire sprinkler system with minimal damage. AFD concluded that AMD officials were unaware of the fire code requirements to report all fires and decided not to issue citations.

Motorola, another semiconductor manufacturer, experienced a similar pyrophoric gas fire at their Ed Bluestein site in 1987. That year, AMD also experienced an overflow of chemicals from an outdoor neutralization tank that drew vapors back into a building. This resulted in 70 employees being evacuated. It also resulted in a $1,200 fine from OSHA for two infractions.

Austin gained national attention again in 1988, when it was selected as the site for another federally sponsored high tech research group. Sematech, a consortium of several semiconductor manufacturers, was brought to Austin on the promise that a facility would be provided by community leaders, local officials, and the state. Once an existing facility was refurbished to house the consortium, employees on

loan from several different high tech companies operated and maintained the research plant. Winning the Sematech plant, and successfully completing a major construction project through government and private cooperation further established Austin's national high tech reputation.

The 1989 Sematech emergency response plan outlined notification procedures that included calling 911 immediately in the event of a fire, explosion, deflagration, smoke or unauthorized release of flammable or toxic materials. It also contained detailed descriptions of the Sematech emergency response team (ERT) training program along with an organization, resource, and operating plan for their ERT. These included direction to notify AFD upon activation of the on-site ERT. Despite this planning, the AFD fire marshal became aware of two hazmat incidents at Sematech that were not reported. On September 25, 1989 a container of combustible solvent pressurized and burst as a result of incompatibility between the contents and the container. This occurred at 11:30 a.m. at which time the immediate work area was evacuated and the Sematech ERT began emergency operations. Sematech personnel did not notify AFD until 5:15 p.m. when the Sematech ERT incident commander called 911 to request additional air bottles from AFD. Another unreported incident occurred on October 16, 1989 when a processing oven at Sematech caught fire. Sematech personnel extinguished it with a halon extinguisher. These unreported incidents resulted in a letter from Austin's Fire Marshal that informed Sematech's chief executive officer that citations would be issued if similar future incidents continued to go unreported. The fire marshal also sent a letter to the Austin Chamber of Commerce identifying the problem of unreported spills and fires.

The incidents resulted in AFD internal discussions regarding a concern that insufficient communication was taking place between AFD dispatch, operations, and prevention divisions. It also initiated discussions in early 1990 between AFD, Sematech, and the Chamber of Commerce regarding

the number of personnel and apparatus sent by AFD in response to what some considered minor hazmat incidents. As a result, AFD instituted a three tier hazmat alarm system that included a "hazardous investigation", a "hazardous condition", and a "hazmat alarm". AFD also prepared a handout to educate industry personnel as to when it was necessary to call for assistance and reporting. The number of units and personnel that each level of AFD response required were included in the handout. Guidelines for deciding what level of response to request were also included. This handout was distributed to local high tech industries and the local press starting in May 1990.

AFD used this example of cooperation to help win a competition for the Austin Quality Award in 1991. The City of Austin, the Austin Chamber of Commerce, and the University of Texas formed the Austin Quality Council to develop a local quality award competition modeled after the Malcolm Baldridge Award on the national level. Despite winning this award, and the initial success of AFD's new initiative to cooperate with high tech industry on reporting, there were problems beginning to surface.

High tech industry embraced the AFD handout and three tier response to the point that AFD hazmat team captains were routinely called to sites for what they considered incidental spills. They were finding that high tech industry personnel did not interpret the handout guidelines the same, where worried about getting in trouble for not reporting, and would call for a hazardous investigation by AFD just to be safe.

Conversely, another incident occurred at Sematech on the morning of January 3, 1991 when about 30 gallons of sulfuric acid was spilled in the research center. Sematech's safety officer was not notified until 9:30 p.m. that evening when he called AFD to report the spill as required by the fire code. AFD again threatened to issue citations. The safety officer was reassigned by Sematech and later fired for

reasons non-related to this incident according to Sematech officials. Never the less, a wrongful discharge lawsuit was filed by the former safety official in July, 1991. As part of that lawsuit, AFD records were subpoenaed and AFD personnel gave depositions concerning City codes, AFD procedures, and specific responses to Sematech. This combined with the AFD hazmat team comments, resulted in discussions within AFD as to the possible need for revisions to the new cooperative system with high tech companies.

During this time, AFD also started becoming aware that some high tech ERT training may not be in accordance with OSHA 1910.120 requirements. This first came to light in discussions with high tech industry environmental health safety professionals during annual AFD hazmat permit inspections. Many described a lack of funds for professional training by outside firms. One EHS professional related how his company did not keep records of ERT personnel training or qualifications as it was too cumbersome, and they moved around too much. His company simply considered their employees as experts in their field, and therefore qualified under OSHA as specialists. Unfortunately AFD had an occasion to witness a lapse in ERT response that verified these concerns.

On May 21, 1992 there was an accidental mixing of a small amount of acid and oxidizer inside a fabrication area at the AMD site. This resulted in the evacuation of 200 workers, production shutdown of 3.5 hours, and 37 employees being treated for various exposure symptoms. It also provided an occasion for the AFD hazmat team to witness the operating practices of AMD's ERT. This included several uncoordinated entries to the release area for investigation, and an initial confusion as to whom was in command of the ERT. At one point, the AFD hazmat battalion chief and an AFD engineer witnessed an AMD ERT member coming out of the potentially corrosive atmosphere wearing spandex

workout shorts and a supplied air breathing apparatus. The AFD battalion chief ordered AMD personnel to change into more protective equipment.

Luckily, this occurred in conjunction with preparations in 1992 to adopt the 1991 Uniform Fire Code. The Chamber of Commerce and its high tech industry members saw this as an opportunity to propose some changes in AFD's reporting requirements. AFD saw this as an opportunity to possibly reduce unnecessary reporting, to increase cooperation with industry and to positively influence the development of the high tech industry ERTs.

The Chamber's environmental health safety subcommittee expressed a concern that companies were not being given credit for the time and expense of having on-site response teams. They asked that AFD consider allowing their teams to respond to minor spills and releases without requiring an AFD unit to come to their site. They felt this would provide an added value to the industry teams and provide an impetus for gaining AFD confidence. AFD used this opportunity to provide further clarification as to when it needed to be called out to a site. This paper will identify how this change was accomplished and evaluate its success.

The above information provides the basis for the need to change the Austin Fire Department methods relating to emergency coordination with local high tech industry. From an organizational perspective, there was a previous attempt to clarify local reporting requirements that did not satisfy local high tech industry customers. This caused AFD to provide further changes in emergency coordination. This paper will evaluate the organizational effectiveness of the additional changes that are in effect at this time. Evaluating the success of these changes should provide beneficial information regarding ideas for possible future revisions.

The nature of the problem studied in this research paper is related to the inability of AFD to appease local high tech industry customers regarding hazmat team responses to their sites. This directly relates to the National Fire Academy course, Strategic Management of Change, as the processes and model taught in that class can be used to not only facilitate new changes, but also to evaluate an earlier attempt at changing fire department coordination with high tech industry emergency response teams.

LITERATURE REVIEW

High tech industry is defined by the Microsoft Encarta Encyclopedia (1998) as that making use of advanced technology. It further describes the largest high tech group to be the fast growing electronics industry, especially the manufacture of computers, microchips, and telecommunications equipment. A search of the computer version of Encarta resulted in the following articles containing the term "high tech": aerospace, automobile, biological research, chemical analysis, computer industry, information storage, medicine, robotics, telephone, television, and video.

The sixteenth edition of the NFPA "Fire Protection Manual" was printed in 1986. It was the first edition to include a chapter on semiconductor manufacturing. Bielen and Robinson (1986) included in this chapter a discussion on management support of loss prevention programs at semiconductor facilities. They predicted that a loss will occur due to employees not being able to react properly during an emergency if management does not organize and train its employees to participate in the plant loss control program. They suggested that a semiconductor plant loss control program address such problems as training personnel to respond to fires and other emergencies, and to inspect and maintain loss control equipment. The eighteenth edition of the NFPA "Fire Protection Manual" was printed in 1997. This edition's chapter on semiconductor manufacturing by Marshall (1997) does not mention on-

site ERT, or even emergency planning at high tech facilities. It does however describe in detail, the automatic fire and chemical release prevention systems installed in most plants today. His description of these mechanical safety systems points out a common philosophy among some high tech managers. There are those who feel that due to all the protective equipment installed, on-site employees trained in emergency response are not necessary.

In contrast, Macklin (1997) describes his experience as a new employee for a semiconductor manufacturer where on his second day, a major site evacuation occurs. The resulting 18 hour shutdown by the local fire jurisdiction confirmed to management that emergency response planning was needed, including an ERT that can coordinate effectively with a well seasoned fire jurisdiction's hazardous materials response team.

Analysis of how well a high tech industry ERT can work with a local Fire Department team is dependent upon the organizational influences that describe what each expects from the other. It is also related to what the public expects from both teams. Legal liability is a concern to all. NFPA associate general counsel, Brodoff (1997) describes a potential liability to fire departments when there is a "special relationship" exception to the "public duty rule". The public duty rule views firefighting as an obligation that governments owe not to an individual but to the public as a whole. This normally provides immunity from damages claimed by an individual as a result of a public fire department response. This is because the fire department's duty is owed to the public and not to any particular individual. Brodoff writes that a special relationship liability is created when firefighters offer a special service or protection to an individual that is not available to the general public.

Attorney Lies (1995) describes this special relationship liability as the "Special Duty" rule. He explains that a special duty arises when a fire department team is uniquely aware of a risk to a non-

firefighter, the team acts without failure or omission, and the non-firefighter is injured while under the direct and immediate control of the fire department team.

Oaks (1998), an attorney and fire marshal for Santa Barbara County, California relates this liability to fire department teams that respond onto private industry sites. He describes how liability can be transferred to the fire department from the on-site team similar to landowner liability. In other words, once the fire department team takes control of an incident, the public responders take on the same liabilities that the landowner has. Oaks defines landowner liability as "who is in control".

Private ERT members must be concerned with liability due to possible negligence or omissions related to OSHA required response training, use of response equipment, and definable exposure levels. They also must be concerned with when it is necessary or required to call for outside assistance from the fire department team, especially when there is not an OSHA compliant team on-site. Misunderstandings occur when a high tech employee does not understand the difference between an incidental spill and an uncontrollable release.

Gallant & Kwid (1992) describe how OSHA's Hazwoper standard defines an incidental spill as a release that employees who are trained under the hazardous communication standard can respond within the scope of their routine jobs. They describe further that it is a spill that may be handled without going outside the employee's daily responsibilities, and without exceeding the level of employees' training. These responders do not have to be trained as an emergency responder to OSHA 1910.120 requirements. They describe an uncontrollable release as posing a true emergency requiring a response by trained personnel from outside the immediate work area. They relate that an employer does not have to train employees in hazmat response if it is the employer's established policy to evacuate the premises and call in outside assistance during an emergency.

The confusion for fire departments and high tech ERT members is in each group's expectations and definitions regarding perceived liabilities, required training, necessary resources, and the ability to know when an incident constitutes an emergency. There are also individual differences between the private ERT members and AFD members. McCay (1995) surveyed nine high tech companies to benchmark ERT programs. He found that 100% utilized educated judgments in determining an emergency, with 27% also using spill quantity limits to define an emergency. Those relied on for making educated judgments were primarily volunteers at 73 % of the companies. Only 9% required ERT membership as part of standard employee job descriptions. Even so, the site Environmental, Health, and Safety Department ran 64 % of the teams. All sites indicated that they trained ERT personnel to the hazmat technician level, but 9% indicated that they did not train personnel to the Incident Command level. Incentives for belonging to a site ERT were listed as no incentive program by 18%, miscellaneous perks by 64%, and salary percentage compensation by 18%. The average high tech industry ERT member turnover rate was 12.5%. Quarterly meetings are held at all locations but only 55% listed the meetings as required. The average number of drills was 3.2 per year, with 64% requiring mandatory ERT member attendance. Local fire department drills were listed at 82% of the sites. The average number of hazmat responses per year was 100, with the average time to activate of 10 minutes. It was pointed out that most of the hazmat responses by on-site ERT personnel were incidental spills, medical calls, or investigation of transient odors.

Analysis of the different liabilities, the differences in team capabilities, and the differences in motivation between public and private team members, appears to be necessary in successfully accomplishing a change in the way a fire department interacts with a high tech industry ERT.

Processes found in two references suggest planning target goals for improved relations between public and private responders. OSHA directive CPL 2-2.9A (1998) concerns hazardous waste operations and emergency response to hazardous substance releases. It outlines a general framework for OSHA inspectors to ensure uniform enforcement of the Hazwoper regulations. The items to be checked include elements of the emergency response plan, the incident command system authorities, responder training, medical consultations, the personal protective equipment program, and contact with the local fire department. This contact by the OSHA inspector is to see if the company has notified the local fire department as to the circumstances under which outside responders will provide emergency response to the facility.

Callan (1993) outlines a six part hazmat emergency planning process that includes policy, prevention, preparedness, procedures, performance, and practice. Policy is a commitment to creating a workable plan. Prevention requires identifying and analyzing problems. Preparedness is based on cooperation and communication. Procedures are established courses of action. Performance is achieved through training. Practice is acquired through experience and drills. Callan notes that attitude is the driving force behind any plan and minimizing any of the six elements will result in a flawed planning process.

Successful implementation of a plan for improving coordination between public and private hazmat teams is referenced in terms of shared vision and specific examples of existing public/private cooperation. Brady (1998), managing director of Salomon Smith Barney Inc. describes how investors are beginning to pay attention to corporate environmental programs that include chemical spill and release prevention:

> Information on the cumulative effect of management actions that produce change in risk or return conditions is of interest to me as an investor," he said. " I am willing to pay for that knowledge through my price tolerance. Your area of specialization is increasingly important in today's management decision....and, therefore has the potential to influence future company change.

Donovan (1992) describes a number of suggestions by the Chemical Manufacturer's Association on how to ensure proactive emergency plans. The list includes cooperative response training with the community and other companies, providing facility tours to local emergency responders, and forming an industry committee among other plants. Donovan relates that an atmosphere of cooperation tends to extend into joint exercises and mutual-aid agreements.

Implementation examples of two such existing groups were found on the Internet. The Refinery Terminal Fire Company (RTFC) of Corpus Christi, Texas (1996) is an example of a private fire brigade and hazmat team funded by member companies associated with the petrochemical industry. The RTFC has been in operation since 1948, and is entirely owned by industrial members consisting of 19 companies, at over 70 locations and billions of dollars in assets. The RTFC has primary responsibility for emergency response to its member companies, but it also responds when requested to assist the Corpus Christi Fire Department. There is a similar organization called the Channel Industrial Mutual Aid Association (CIMA) that is located near Houston, Texas. It is a mutual aid group consisting of fire brigades from chemical plants and refineries along the Houston Ship Channel. CIMA regularly participates in area emergency drills with several local emergency planning committees such as that described by the City of Pasadena, Texas LEPC (1999). Riecher (1997) describes how it recently was requested to assist the Houston Fire Department with multiple alarm fires at a chemical warehouse that ignited twice in two weeks. Industrial fire brigades can be found throughout the United States and have

a long history. There are numerous examples of industrial fire brigades aiding nearby public fire departments. This is not as common in the high tech industries.

The annual Industrial Fireworld Conference (1998) in Houston, Texas is a convention of industrial emergency responders, mostly petrochemical industry representatives. Likewise, the programs and speakers usually cover topics of interest to the chemical and petroleum industries. This changed at the 1998 conference. A speaker from the high tech industry was included for the first time, to talk about a response team training program for the semiconductor industry.

In addition to a non-traditional emergency response topic for industry, a reference was found that describes a non-traditional means of improving industrial productivity. The Best Manufacturing Practices Center of Excellence (BMPCOE) began in 1985 and is sponsored by the Office of Naval Research. BMPCOE collects voluntary surveys of best practices in industry, government, and academia in an effort to improve product price, quality, and delivery. Harris Semiconductor provided one such survey in 1994 with revisions in 1998. It included an entire section relating to practices of the Melbourne, Florida site emergency response team (ERT). The Harris ERT program was started as a result of recommendations from a management committee that was investigating ways to meet new chemical spill/release requirements. The on-site ERT was described as having helped to reduce personnel injury risks and property loss. Harris Semiconductor also found the ERT to provide a positive impact on production. Previously, when an alarm triggered, the local fire department was called to a building where personnel had already been evacuated. The fire department would then conduct a walk-through taking more than 45 minutes to determine if it was safe for employees to return. Now that the on-site ERT is trained, their personnel respond directly, and determine if it is a false alarm or something minor. This information is passed on to the fire department and usually everyone can be back

at work within 10 minutes. Harris Semiconductor found this improvement to not only save production time, but also to reduce the risk of product loss that can occur due to a timed process being left unattended.

Evaluating a change in emergency response capabilities includes reduction of liabilities and business interruption. It also includes protection of the public. An incident in Santa Barbara, California on December 1, 1997 illustrates how a company's on-site response team can become involved in misunderstandings and perceptions of failure to protect the public. It also demonstrates the legal action that can result.

Planning Director, J. Patton and Fire Chief, K. Simmons (personal communication, December 9, 1997), provided a description of the incident in a memo. They relate how seven fixed hydrogen sulfide (H_2S) monitors at the Chevron Point Arguello Oil and Gas Plant in Santa Barbara County, California were activated at 9:19 p.m. At 9:29 p.m. two motorists who had driven by the plant called the California Highway Patrol (CHP) because the passenger became nauseous from the smell. At 9:32 p.m. the Chevron operator called 911 and reported to the Fire Department that there was a small gas leak, that there was no need for Fire personnel to respond, but to stand by in case a response became necessary. As a precautionary measure the plant was shut down and Chevron personnel began sweeping the site with hand-held monitors. During this sweep, one hand-held monitor "pegged" at its maximum measurement of 999 ppm. Chevron later estimated that the concentration was about 20,000 ppm. At 9:55 p.m. the CHP contacted Chevron regarding the passing driver's call. Chevron requested CHP to close Highway 101. Chevron personnel with handheld monitors began walking along the frontage road between the Chevron plant and the highway at about 10:00 p.m., with no detectable reading of H2S. Even so, the H_2S odor of rotten eggs was reported from a facility across Highway 101

from Chevron. It was later reported that once instruments pegged, their accuracy could be considered questionable. The Fire Department was contacted, and at 10:20 p.m. a response unit arrived at the site. Additional monitoring was conducted by the fire department and by 10:45 p.m. readings of 0 ppm were documented. At 11:15 p.m. the highway was reopened to traffic. At least six vehicle occupants were exposed and reported suffering nausea, headaches, dizziness, and other symptoms. Another "threw-up" in his car. None of the victims reported long term effects.

Following the incident, several investigations by local public agencies were started. In a memo from Planning Director J. Patton and Fire Chief K. Simmons (personal communication, December 9, 1997) the following was discussed:

> Chevron responded to the release as if it were a Level 1 incident. However, there are at least three circumstances which elevate the incident above a Level 1. First, the release was initially thought to be 50 ppm. A level 1 incident is for an H_2S gas release of up to 25 ppm. Any release greater than this is at least a Level 2 incident. Second, since the leak lasted for 28 minutes, conservative judgment would characterize this as a sustained release, also one of the criteria for a Level 2 incident. Lastly, the gas leak moved off-site affecting passersby. Off-site impact dictates the closure of nearby Highway 101, and is one of the criteria for a Level 3 incident. By declaring the incident a Level 3 incident, Chevron would have more accurately communicated what was taking place, which would have heightened the level of response from the Fire Department, increasing the number of available response personnel. It is important for Chevron to correctly characterize the level of emergencies, because responses to each level are designed to protect Chevron and the public. A quicker and more accurate determination of the level of the incident may have avoided some of the Highway 101 motorists being exposed to the gas release.

An investigation report by Fire Investigator, D. Delgato (personal communication, December 2, 1997) indicated Chevron personnel felt that escalating the response to Level Two or Three was not justified. They did not believe the leak qualified as "sustained", and explained that there was no specific definition for sustained because plant operators need flexibility when evaluating circumstances on different incidents. They interpreted a gas leak spreading off-site as being defined only by measurable amounts on instrumentation outside the plant boundaries.

It turns out that Chevron and the County agencies did not define these criteria in the same manner. Further investigations stemming from complaints by the Environmental Defense Fund continued through the winter, spring, and summer of 1998. A letter to the County Administrator, by the Santa Barbara County District Attorney, T. Sneddon (personal communication, July 15, 1998) stated the following opinion:

> The problem is that the matrix criteria are expected to serve a dual purpose. One, as emergency guidelines, and secondarily, as legal requirements. They are not suited for either purpose. They are vague, ambiguous, and subject to different interpretations. From an emergency response perspective, the broad discretion given by the vague criteria hampers the ability to effectively respond in an emergency situation.

The District Attorney further described how a Stipulation and Judgment was filed in Santa Barbara Superior Court on July 15, 1998. It provided that Chevron pay civil penalties of $35,000 and District Attorney costs of $5,500. It also stipulated numerous improvements to process equipment, monitoring equipment, and the following:

> Promptly meet with responsible government agencies including, but not limited to, the Fire Department and Energy Division of Planning and Development for the purpose of arriving at

mutually agreeable definitions for the matrix criteria utilized in categorizing level one, two and three emergencies.

The Santa Barbara County Sheriff, J. Thomas (personal communication, July 20, 1998) outlined steps taken by several agencies following the incident in a memo to the County Administrator. His report outlined several revisions to Chevron's Emergency Response Plan Matrix, Highway 101 closing procedures and Chevron's use of an incident command system compatible with the County. In addition, an after-hours surprise exercise at the facility was accomplished to test Chevron personnel. The Sheriff also described the following concerning changes to Fire Department response:

> Even though oil and gas processing facilities are extremely complex and company representatives obviously have a greater understanding of their processes, Fire Department response personnel have received instruction not to rely solely upon a company representative's size-up for an incident. The December 1, 1997 Chevron incident proved that a company's size-up may be underestimated so as not to alarm responding personnel to the full extent of an internal facility event. As a result, a company representative's perspective of an incident will be critically scrutinized and the ultimate size-up will be made by Fire Department response personnel.

The Santa Barbara County Board of Supervisor's interest continued through the summer relating to a Chevron proposal to move H_2S processing to an offshore facility. An update on this incident was presented to them at a hearing in September. County Administrator, M. Brown (personal communication, September 15, 1998) described the following in a memo for that hearing:

> To ensure that full Fire Department response is triggered for any H_2S release, regardless of the number or level of alarms, the Matrix will be revised to categorize any airborne release of toxic gas (e.g., H_2S and ammonia) as a Level II incident. A Level II incident involves a typical Fire

Department response of a first alarm which is 3 engines plus a chief officer, code 3 (with red lights and siren). The responding battalion chief may downgrade the response if appropriate. The Incident Commander in a Level II incident is the highest ranking on-duty operations person from Chevron until relieved by the Fire Department.

The original Chevron emergency response plan took 4 years to complete in 1991. Evaluation and institutionalization of the plan as a result of the December 1, 1997 incident took approximately 9 months.

PROCEDURES

This evaluative paper will utilize the Change Management Model (CMM) taught in the National Fire Academy course, Strategic Management of Change, to answer two research questions. The first three phases of the CMM include analysis, planning, and implementation. They will be used to answer the first research question concerning how a change was made to improve Austin Fire Department (AFD) coordination with high tech industry emergency response teams (ERT). The last phase of the CMM involves evaluation and institutionalization. It will be used to answer the second research question concerning the success of this change.

The actual methods used for accomplishing the desired change will be determined from AFD documents, and from personal knowledge of involved personnel. The actual change methods will be evaluated in retrospect to determine if they correlate with the first three CMM phases. The CMM Phase I (Analysis) will be used to evaluate if actual organizational conditions necessitated the change, if actual destabilizing forces were anticipated, if the requirements for bringing about the change were anticipated, and if actual organizational change requirements were determined. The CMM Phase II

(Planning) will be used to evaluate if force for-and-against were anticipated, if personnel were selected to develop a vision of the change, if target goals were set, if a method of change was selected, and if techniques to promote the change were selected. The CMM Phase III (Implementation) will be used to evaluate if a common vision was created, if effective communications were established, if a sense of urgency was created, if enabling mechanisms were developed, and how actual implementation occurred. It is intended that this paper's first research question be answered by evaluating the correlation between the actual change methods used, and the first three phases of the CMM.

The CMM Phase IV (Evaluation/Institutionalization) will be used to evaluate the implementation success, to evaluate potential modifications, to evaluate how well the change has been institutionalized, and to evaluate if the implementation should continue to be monitored. The implementation success will be evaluated by use of historic data concerning AFD hazmat team responses, by use of a survey completed by high tech response team personnel, and by use of historic data concerning industry growth in Austin.

A possible increase or decrease in AFD hazmat responses to high tech locations might be attributed to several factors. It might be a result of prevention or safety program effectiveness. It might be due to a simple increase or decrease in the number of high tech businesses. It might also be an indicator of on-site ERT capability that impacts the necessity for AFD response.

The number of hazmat incidents at high tech facilities will be compared to the number of hazmat alarms at all permit locations, and the total number of hazmat calls in Austin. Information from the AFD emergency report database will be queried using the computer program Microsoft Access. This will result in a total count and incident descriptions for all hazmat calls in Austin from 1991 to 1998. This

response listing will be reviewed to identify high tech locations and a count will be made to determine the total number of responses to high tech industry sites.

AFD inspects locations holding a hazardous materials permit on annual and semiannual schedules. The number of AFD hazmat responses to fixed locations that are inspected for prevention purposes will be determined by comparing the list of hazmat incident locations to that of current AFD hazmat permit locations. This comparison will be accomplished automatically using standard software capabilities in Microsoft Access. A total count of AFD responses to permit holding locations is anticipated to be an indicator of prevention effectiveness.

The annual number of AFD hazmat responses to high tech facilities will be compared to those at all permit locations, and to the total number of hazmat calls in Austin. Each of these data sets will be presented graphically, and a linear regression performed on each. The linear regression will be accomplished using Microsoft Excel computer software in order to determine if each dataset are on the increase or decrease. Implementation success will be judged by whether or not the response history trend for annual responses to high tech sites mimic those for all permitted (inspected) sites, and for all AFD hazmat response locations. The difference in prevention efforts at high tech sites, compared to other permit (inspected) sites, is mainly the presence of a trained emergency response team. Implementation success will be indicated if the trend for AFD responses to high tech sites is decreasing each year while those for other sites are increasing. A limitation inherent in this evaluation is the possibility that each year high tech permit locations utilize more advanced equipment that is safer, resulting in less AFD responses.

To evaluate potential modifications, members of high tech industry ERTs will be surveyed. The purpose of the survey will be two-fold. First, it is intended to substantiate that lower response trends

might be attributed to corporate management and AFD providing adequate support. Second, it is intended to provide an indication of how well the coordination change has been institutionalized by both the high tech companies and AFD.

Corporate management providing adequate support will be determined by direct questions relating to training provided, resources provided, and whether members understand their team's response capability. Survey answers regarding response capability will be compared to the existing ERT capabilities determined by AFD staff during the approval of high tech industry hazmat release reporting protocol submittals. The AFD staff approval of reporting protocols is required by the local fire code amendments described earlier and shown in Appendix A. The survey questions concerning management support will be supplemented with questions concerning AFD support of their team.

By giving high tech industry ERT members an opportunity to anonymously provide this information, success will be judged by whether or not their answers substantiate the earlier annual response trends. Success will be substantiated if the survey answers indicate that team members receive adequate support, if team members correctly indicate their team's response capability, and if team members indicate that substantial institutionalization of the change has occurred.

An International City Management Association publication describing the preparation, use, and meaning of citizen surveys will be used as a guide in wording survey questions, and analyzing the survey results. The number of OSHA 1910.120 trained ERT members is reported on hazmat permit applications submitted to AFD. This information will be totaled for those companies identified as high tech to obtain an estimate of the total high tech ERT member population in Austin. The survey population will consist of high tech ERT members who are taking OSHA 1910.120 required training sponsored by the Centex ERT Forum. The surveys will be conducted over a one year period so as to

include a representative sample. The one year survey schedule should also ensure that duplicate surveys are not be filled out as ERT members are not likely to attend 24-hour hazmat responder, or 8-hour refresher training twice in the same year. Limitations of the survey include the possibility that ERT members will attempt to answer the questions in a manner that will appease their company and AFD. Also, not all high tech companies in Austin utilize the Centex ERT Forum hazmat training to meet initial emergency response or annual refresher training.

Business growth in the Austin area may be attributable to an increase in AFD hazmat responses at high tech facilities. Verification of an overall growth trend in high tech companies will be used to evaluate if monitoring this change should continue. To evaluate this potential effect, the number of AFD hazmat permits granted in years 1991 through 1998 will be totaled. The data used will be obtained from initial issue date information stored in the AFD hazmat permit database. This list of all permits granted each year will be reviewed to determine a count of those considered being high tech businesses. The annual total number of hazmat permits and the annual number of high tech hazmat permits will be graphically displayed. Linear regression will be performed to determine possible increasing or decreasing trends. Success will be indicated if the earlier annual response trend to high tech locations decreases, even though the number of high tech and total permit locations increase. The limitation described earlier concerning the use of safer process equipment might also be applicable for new high tech locations.

In summary, the first three phases of the CMM will be used to answer the first research question concerning how a change was made to improve Austin Fire Department (AFD) coordination with high tech industry emergency response teams (ERT). The last phase of the CMM will be used to answer the second research question concerning the success of this change.

RESULTS

Phase I- Analysis

Task 1.1- Organizational conditions compared to existing mission, standards, values, and norms.

The AFD internal condition was that it used advertising of informal reporting criteria in an earlier attempt to reduce unnecessary business interruption at high tech facilities. This informal reporting criterion was determined to be easily misinterpreted by high tech industry ERT members. This confusion resulted in reporting of incidental spills and unnecessary runs by AFD. The lack of adequate training was determined from observations made by AFD during responses and drills. This resulted in mistrust of the high tech industry ERT by AFD firefighters.

Task 1.2- Identify potential destabilizing forces. It was anticipated that forces existed outside AFD that could provide opposition to a proposed change. Those anticipated included political forces, in the form of local firefighter union members. It was anticipated they might feel that AFD reliance on an inadequate high tech industry ERT would result in a threat to firefighter safety. Another anticipated force was social, in the form of local activist group members representing neighborhood and environmental interests. It was anticipated that activist group members might feel high tech industry was being given authority to self-regulate itself regarding potentially dangerous spills and releases. The final destabilizing force anticipated was economic, in the form of high tech industry employees who might delay in calling for AFD when confronted with a situation beyond their capabilities. It was anticipated that they might do this in an attempt to alleviate production interruptions.

Task 1.3- Assess the impact of organizational conditions and potential destabilizing forces.

Anticipated current requirements to bring about change included the need to include potential fire code enforcement. Anticipated near-term requirements to bring about change included issues related to high

tech industry ERT members obtaining adequate response training. Anticipated long-term requirements to bring about change included issues related to building trust between high tech ERT members and AFD firefighters.

Task 1.4- Determine organizational change requirements. It was anticipated that the perspective of change needed was that of developmental change. It was felt that developing existing skills and standards would be more appropriate than completely replacing them as required in the transitional and transformational perspectives. It was felt that the existing mission of safely reducing responses still needed to be met. It was felt that the existing AFD enforcement mechanisms simply needed to be further defined. Also, existing OSHA and NFPA standards for response training needed to be further implemented. Finally, it was felt that the existing organizations for accomplishing emergency response were simply in need of improved coordination and trust.

A pace of change was needed that would allow industry to have time to accomplish the necessary training and resource analysis. It was decided the scope of this change should be a voluntary requirement rather than mandatory for all high tech businesses. The objects needing change included those on an individual level of getting ERT members knowledgeable as to when AFD wanted to be called out. The necessary change in strategic direction was ensuring that ERT responders could handle small spills in a legal manner without AFD assistance. The change needed in organizational culture was identified as revising the present beliefs of ERT personnel and AFD responders.

Phase II- Planning

Task 2.1- Systematically examines the forces for and against change. The facultative forces for change that AFD anticipated included members of the public who want high tech industry to operate safely. The industry management who wants good public relations yet doesn't want major interruptions

in production due to minor incidents. The AFD personnel, who want firefighter and public safety by being called early in a potential incident, yet not get called out for minor incidents. The restraining forces against change were anticipated to be:

- A lack of commitment by AFD and industry management as regards providing resources, training, and personnel.
- A lack of ERT personnel volunteering throughout all production shifts each day.
- A lack of AFD personnel time for non-emergency drills and scenario training with industry.
- A lack of experience by ERT volunteers in responding to incidents where they might be in peril.
- A lack of trust by ERT members in AFD personnel not knowing their facility needs.
- A lack of trust by AFD personnel in assuming those ERT priorities might not be protecting the public.

The possibility of strengthening the facultative forces provided by the desire for public safety, positive industry public relations, and appropriate incident notice was not specifically discussed. However, it was evident to those involved that AFD needed to promote the professionalism of ERT personnel in order to overcome the restraining forces. To further reduce the restraining forces, it was decided that AFD would need to audit resources, training, and dedicate time for AFD participation in drills.

Task 2.2- Select personnel to develop a vision for the organizational change. An executive/senior officer team strategy was used for developing a vision for this change. AFD Prevention Division professional engineering staff was already working with high tech industry safety professionals on developing a vision through the Fire Code Amendment process. The Prevention Division's senior fire protection engineer and senior hazmat engineer developed the fire department vision along with input

from the Fire Marshal and Special Operations Battalion Chief. It was felt a team approach would be better than an Executive Leader alone setting goals. Likewise, the time frame needed to get fire code approval would not allow the time needed to utilize a bottom up approach with involvement of line workers who might not see the whole picture.

Task 2.3- Envision the organizational change to be implemented. The desired state to be achieved was partially decided by the Chamber of Commerce EHS subcommittee who requested the change to allow private industry ERT's to not call 911 regarding spills and releases that they could handle safely. AFD refined this to a desired state that ERT's should be able to respond to incidents that they are capable of handling, in a safe manner to protect employees, without endangering the public, or firefighters. It was felt by AFD that this vision provided a customer service orientation in that it was agreed that AFD should allow ERT's to do their job. It also identified expectations for providing an optimum condition by high tech industry ERTs.

The road map for this change was loosely designed as starting with a change in local fire code that would necessitate formal reporting agreements. These were followed by an expectation that AFD would need to promote adequate training of ERT personnel. Similarly, AFD anticipated that annual drills with industry response teams would be necessary. AFD anticipated that initially it would need to be a critic at these drills and actual responses. The final point on the road map was that AFD needed to audit and inspect the high tech industry ERT training and resources in order to ensure that the change was instituted.

The need for providing inspiration and emotional appeal for this change vision was not anticipated by AFD. With ERT members being mostly voluntary, AFD worried that they might not take their response roles seriously, as dealing with peril was not a daily event. Luckily, soon after changing the fire

code an informal group called the Centex ERT Forum was formed by ERT representatives from companies in the Austin area. Primarily, this group became an avenue for providing inspiration and emotional appeal as it helped legitimize high tech ERT member efforts. Secondarily, it allowed ERT members to hear about issues that others had encountered and thereby gain important experience. Finally, it created a place for AFD to interact with the ERT leaders in a non-regulatory setting and in more of a peer role.

Task 2.4- Set and evaluate target goals and objectives of the envisioned change. Quantifiable target goals were incorporated in the form of local fire code amendments. A copy of the original 1991 Uniform Fire Code requirements and the revised local amendment wording is provided in Appendix A. The first target goal was providing written agreements that included specific reporting quantities, based on an assessment of resources available to a high tech industry ERT. Second was requiring proof of adequate training. Third was the requirement for quarterly ERT drills including an annual drill that included AFD personnel. Fourth were ongoing audits by AFD inspectors as part of existing hazmat permit annual inspections. It was decided that the last target would benchmark the entire change and keep it from being blown off course.

Task 2.5- Select the method of change to be employed. It seemed at the time to AFD staff that they were being asked to alter the way they provided services, as included in a technical method of change. That was not the case, as high tech industry still wanted AFD to respond to hazmat incidents that required their expertise. Some high tech officials also initially interpreted that AFD was trying to influence corporate cooperation with labor as in the managerial method of change. This was may have been somewhat true in real life when AFD placed specific performance requirements on ERTs. These

specific requirements actually proved to be performance measures rather than a change method. The real method of change incorporated some aspects of structural change and some people changes.

The proposed change required a modification in roles as included in structural change. High tech ERT members were required to assume the role of an emergency responder rather than a corporate worker. The organizational structure also had to incorporate a shift from a production team structure to one of emergency response team. These planned interventions into the organizational life of corporate production were similar to those described in a people method of change. High tech ERT members were required to interrupt their corporate production activities in order to upgrade their knowledge through hazmat technician and incident command training. They were required to participate in team-building activities such as quarterly drills, including some with members of the AFD hazmat team. They also were required to understand the system wide processes outside their areas of production expertise, and how they determine when to call AFD for assistance.

Task 2.6- Select techniques to promote the change. AFD audits by inspectors were envisioned by AFD as the main technique for promoting change, however these actually became a benchmark. The real technique to promote change was not political, as the local fire code ERT requirements were only applicable to those businesses that decided to fund a team, and propose reportable quantities. This made the code change somewhat voluntary rather than political. High tech ERT responders were provided the means to accomplish the change themselves, similar to that of a facultative technique.

While not initially discussed, opportunities became available later to utilize some informational and attitudinal techniques to promote the change. The rational for when to call AFD was discussed during drills, incident critiques, and public speaking opportunities attended by high tech ERT responders and AFD hazmat team responders. These discussions took place at Centex ERT meetings and during

several monthly AFD hazmat team meetings. Promoting information exchange was also believed to provide some attitudinal change by helping ERT responders understand AFD motives and attitudes concerning their capabilities.

Phase III- Implementation

Task 3.1- Create an environment of shared vision and common direction. Promoting overall support of the envisioned change required an effective means of announcing it. There was no formal announcement to individual ERT members, however this was accomplished as part of the fire code adoption process. The proposed change was first proposed by high tech industry representatives in discussions with the Greater Austin Chamber of Commerce EHS subcommittee. AFD staff then discussed the proposed change with the Local Emergency Planning Committee, the City Environmental Board, the City Appeals Board, and finally the City Council, where it was formally adopted. Political sponsorship of the change was initially held by AFD in primarily the prevention division through its Hazmat Engineering Section. This was expanded upon adoption of the code change to include the AFD Operations Division through its Special Operations Section. Sponsorship expanded further with each of five high tech industry companies that pursued a reporting agreement with AFD. It was also extended to the Centex ERT Forum once that group became aware of training needs and they organized joint hazmat refresher training attended by industrial personnel from different companies.

Task 3.2- Minimize initial resistance to change through effective communications. Communications relating to the change in AFD policy regarding reporting and the expected capabilities of industry teams were not specifically planned at the time of the code change. Once adopted, AFD was given the opportunity to present its requirements to the Centex ERT Forum and the Travis County Local Emergency Planning Commission. Both included high tech industry ERT leaders where AFD

requirements were explained and questions answered. Copies of the AFD requirements were provided, and examples of resource evaluation calculations were presented and made available. AFD also discussed the new code change individually with those high tech industries scheduled for annual hazmat permit inspections. This was the only attempt to inform high tech businesses that did not participate in the code change or other ERT organizations.

Task 3.3- Create a sense of urgency and pace for the change. It was anticipated that any sense of urgency and pace of change would be dependent upon corporate interest in meeting the new ERT requirements and formalizing a reporting protocol for their site. Those businesses with representatives on the Chamber of Commerce subcommittee that proposed the change were expected to have an urgent need and therefore would exhibit the fastest pace in proposing reporting protocols. This proved to be an inaccurate assumption as the first company to provide ERT personnel, resource, and training information as part of a request for reporting protocol did not do so until 20 months after the fire code change was adopted by City Council. In addition, there were only 4 other industrial sites that proposed protocols over the next 4 years.

Task 3.4- Develop and implement change enabling mechanisms. Practical change mechanisms were utilized by AFD. These included the local fire code change, the annual inspections, the ERT training required, and the quarterly ERT/annual AFD drill requirements. Those high tech industry businesses that created ERTs adopted different symbolic change mechanisms that ranged from pay stipend awards and annual banquets as rewards for ERT participation. Most ERT maintenance remains centered in the company EHS department with voluntary participation from other areas of the company.

Task 3.5- Implement planned change methods and strategies. Implementation was citywide and not limited to just high tech industries that had requested the change. Support for the change was

obtained during the local fire code adoption process. AFD had no formal plan for informing middle managers responsible for ERT upgrades as this was expected to be handled by leaders within those companies requesting special accident reporting status. As described earlier, creation of the Centex ERT forum did provide opportunities for AFD to implement its strategy for obtaining adequate training for local ERT members. AFD did this by participating in development of the training curriculum and by providing facilities to hold the training.

Research Question Number 1 - How were changes made in coordinating with high tech industry hazmat teams? Description of the actual change above, using the first three phases of the CMM includes the many items necessary for analysis, planning, and implementation. This part of the paper answers the first research question. The first three CMM phases described above, not only describe how the actual change took place, but it allows evaluation of how well the change phases were followed. The last phase of the CMM will be used to answer the second research question posed in this paper.

Phase IV- Evaluation/Institutionalization

Task 4.1- Evaluate initial change implementation. A possible result of implementing the change is shown below in Figure 1. Three linear graphs were plotted on logarithmic scale with the number of hazmat alarms on the y-axis (vertical) and the year they occurred on the x-axis (horizontal). The three sets of data plotted were for total number of hazmat alarms, the number of hazmat alarms to AFD permit sites, and the number of hazmat alarms to high tech sites. Linear regression calculations, to fit a line to the data, were accomplished by using Microsoft Excel software. The linear graphs show an increasing slope or trend of +39.4 alarms per year for all hazmat alarms, an increasing slope of +2.1 alarms per year at all AFD permit sites, and a decreasing slope of -2.2 alarms per year at high tech

industry sites. The correlation coefficient of the linear fit was 0.84 for all hazmat alarm data, was only 0.39 for AFD permit site data, and was -0.86 for high tech industry site data. The standard error calculated was 67.4 for all hazmat alarms, 12.9 for AFD permit site alarms, and 3.4 for high tech industry site alarms.

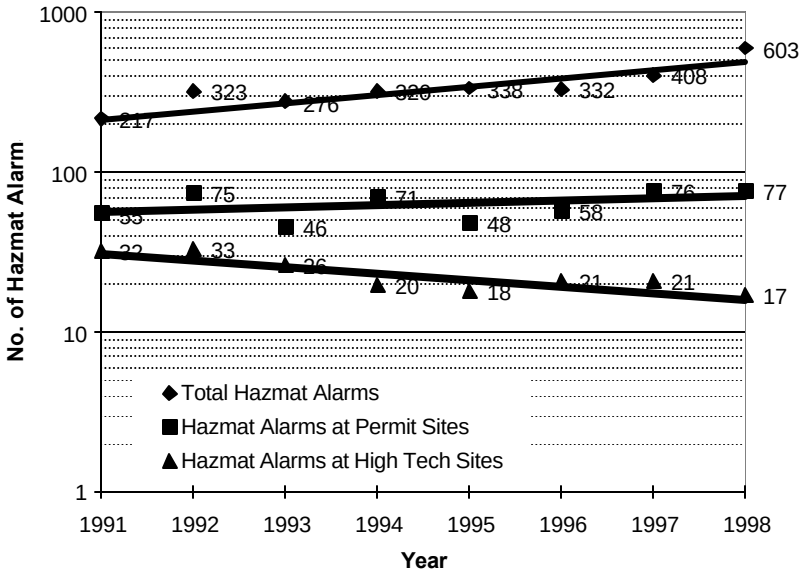

Figure 1. Total hazmat alarms, hazmat alarms to AFD permit sites, and hazmat alarms to high tech industry sites.

The above evaluation indicates that even though hazmat alarms at all sites and hazmat permit sites are increasing, the alarms to high tech industry sites are decreasing.

Task 4.2- Alter/Modify change management approach. The number of high tech industry ERT personnel reported on AFD Hazmat Permit applications are shown in Appendix B. Seventeen high tech industry sites report that they had a total of 382 ERT personnel at the time of their last permit renewal. The personnel survey accomplished during annual Centex ERT training sessions provides information for

evaluation regarding how the change in AFD coordination has influenced high tech industry ERT members and if some alterations are necessary.

As shown in Appendix B, there were 398 who attended Centex ERT forum training. However, 49 were excluded because they did not answer one or more questions on their survey. This left 349 respondents to the survey, only 84 less than the total 382 responders reported in all of Austin. However, since not all companies in Austin send their personnel to Centex ERT annual training, it was felt that a correlation between the survey results from the group attending Centex ERT, and all responders in the City should be considered informal.

A copy of the survey questionnaire used is included in Appendix C. The number of survey respondents was broken down by the job descriptions used in survey question 1. The following Table 1 shows that the high tech industry hazmat teams sending personnel to Centex ERT training are primarily made up of production personnel, with the total for EHS personnel, facilities, and management positions making up the rest of the team. Table 2 shows that the survey respondents taking the Centex ERT training have predominantly 0-2 years of experience on a high tech industry ERT as determined from survey question 2.

Table 1

Survey Question 1 - Primary jobs of those on high tech industry hazmat teams answering survey.

Job Description	Number of Respondents

Administration	10
Environmental, Health, Safety	48
Facilities	32
Management	31
Production	228
TOTAL	349

Table 2

Survey Question 2 - Years of experience on high tech industry hazmat teams answering survey.

Experience (Years)	Number of Respondents
0 - 2	202
2 - 4	64
4 - 6	42
6 - 8	15
Greater than 8	26
TOTAL	349

The above evaluation indicates those production personnel, with less than 2 years of ERT experience are the target group if a need to modify the change is directed at ERT members themselves. The following survey questions 3, 4, 5 and 6 were intended to provide information that would indicate if a need is necessary for AFD to modify the change as it relates to ERT leaders and corporate sponsors.

Question 3 resulted in the majority opinion that the high tech teams are proficient at using the equipment provided. Question 4 resulted in the majority opinion that high tech teams are proficient at analyzing risk to employees and the public. Question 5 resulted in survey respondents indicating their team capability was limited to less than 300 gallons of acid. Question 6 was a direct question regarding corporate expectations. The majority opinion was that high tech ERT personnel were not pressured to perform beyond their capabilities.

The first six survey questions were intended to provide information that would indicate a need for AFD to modify the change as might be directed at the team members, team leaders, or corporate sponsors. The results for questions 3 to 6 are shown as follows with the percent answering each opinion category. The results for each question were split into two levels depending on the years of experience indicated earlier.

Survey Question 3. Your ERT is proficient at utilizing the personal protective equipment, decontamination equipment, and other spill/release equipment provided to them.

	Strongly Agree	Agree	Disagree	Strongly Disagree
0-2 years experience	20.3 %	69.3 %	10.0 %	0.4 %
2-8+ years experience	34.7 %	57.2 %	5.4 %	2.7 %
All respondents	26.4 %	64.2 %	8.0 %	1.4 %

Survey Question 4. Your ERT is proficient at determining whether there is a risk to employees and the public, then taking the appropriate actions.

	Strongly Agree	Agree	Disagree	Strongly Disagree

0-2 years experience	28.2 %	66.4 %	5.4 %	0 %
2-8+ years experience	40.8 %	53.1 %	4.1 %	2.0 %
All respondents	33.5 %	60.7 %	4.9 %	0.9 %

Survey Question 5. Check the maximum quantity of acid, spilled outside of containment, that you believe your site's ERT has the resources and ability to control and clean-up (in less than three hours).

	0-55 gal.	55-300 gal.	300-3000 gal.	More than 3000 gal.
0-2 years experience	71.8 %	21.8 %	3.4 %	3.0 %
2-8+ years experience	66.7 %	27.9 %	3.4 %	2.0 %
All respondents	69.6 %	24.4 %	3.4 %	2.6 %

Survey Question 6. Our company expects too much from our team in the event of a real emergency.

	Strongly Agree	Agree	Disagree	Strongly Disagree
0-2 years experience	4.5 %	14.9 %	72.2 %	8.4 %
2-8+ years experience	4.8 %	15.6 %	61.9 %	17.7 %
All respondents	4.6 %	15.2 %	67.9 %	12.3 %

The above evaluation indicates that high tech industry ERT personnel feel they are given the tools to operate safely, they can adequately determine risk, they know the capability of their team, and they are not expected to perform beyond their capabilities. The last three questions evaluate if high tech ERT members feel that AFD is providing adequate assistance. This is intended to provide information that will indicate if there is a need for AFD to modify the change in how it coordinates with high tech industry ERT members.

Question 7 resulted in the majority opinion that AFD does not over-react when responding to hazmat incidents at high tech sites. Question 8 resulted in a slight majority opinion that AFD adequately participates in high tech industry drills. This however was not an overwhelming majority. Question 9 resulted in a majority opinion that AFD is considered a partner to their team.

The last three survey questions are intended to provide information that would indicate a need for AFD to modify the change concerning response coordination, participation in drills, and relationships with ERT members. The results for questions 7 to 9 are shown as follows with the percent answering each opinion category. As before, the results for each question are split into two levels depending on the years of experience indicated earlier.

Survey Question 7. AFD typically over-reacts when responding to hazardous material incidents at our site.

	Strongly Agree	Agree	Disagree	Strongly Disagree
0-2 years experience	1.5 %	8.4 %	76.2 %	13.9 %
2-8+ years experience	6.8 %	15.0 %	66.0 %	12.2 %
All respondents	3.7 %	11.2 %	71.9 %	13.2 %

Survey Question 8. AFD participation in our team's training and drills is not adequate.

	Strongly Agree	Agree	Disagree	Strongly Disagree
0-2 years experience	0 %	30.7 %	58.9 %	10.4 %
2-8+ years experience	5.4 %	28.6 %	57.2 %	8.8 %
All respondents	2.3 %	29.8 %	58.2 %	9.7 %

Survey Question 9. AFD is a partner to our team.

	Strongly Agree	Agree	Disagree	Strongly Disagree
0-2 years experience	29.2 %	58.4 %	10.4 %	2.0 %
2-8+ years experience	32.7 %	58.5 %	8.2 %	0.6 %
All respondents	30.7 %	58.4 %	9.5 %	1.4 %

Task 4.3- Continue to monitor and institutionalize change implementation. The opportunity to institutionalize the change grows each year as shown by Figure 2. AFD hazmat permit data is plotted on logarithmic scale with the number of hazmat permits on the y-axis (vertical), and the year on the x-axis (horizontal). The two sets of data plotted are for total number of hazmat permits at all sites in Austin, and the number of hazmat permits at high tech sites only. Linear regression calculation to fit a line to the data was accomplished by using Microsoft Excel software. The linear graphs show an increasing slope or trend of +103.7 permits per year for all hazmat sites, and an increasing slope of +11.3 permits per year for high tech industry sites. The correlation coefficient of the linear fit is 0.98 for all hazmat permit data, and 0.99 for high tech industry permit data. The standard error calculated is 49.1 for all hazmat permits, and 4.59 for high tech industry permits.

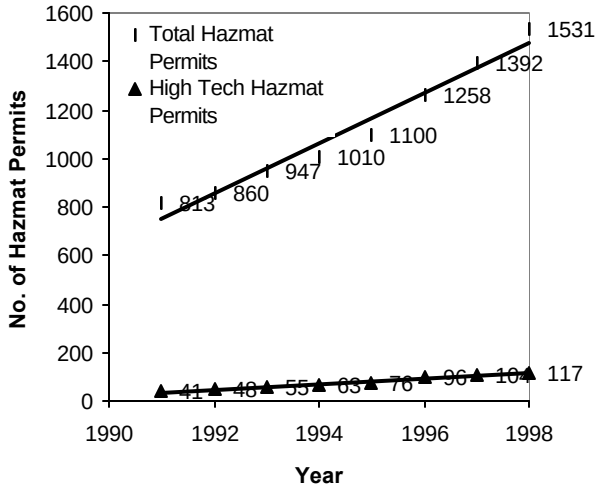

Figure 2. The growth of hazardous material permits for all types of sites and those for high tech sites.

The above evaluation indicates that hazmat permits in Austin and at high tech industry sites are increasing. Even so, hazmat alarms at high tech industry sites are decreasing as shown in Figure 1.

Research Question 2 - How successful is the change? The last phase of the CMM is used to answer the second research question in this paper. As shown above, it appears that the change has resulted in tangible response results by helping to create a trend toward less AFD hazmat team responses to high tech industry sites. It appears the change was successful in helping to increase high tech industry ERT capabilities and their opinion concerning AFD members. Last, the increasing trend in high tech sites indicates that opportunities for the change will continue to grow in Austin, and perhaps be even more successful.

DISCUSSION

The relationship between the findings of others described in the reference section, and the study results in this report follow the four phases of the Change Management Model (CMM). Phase I (Analysis) was identified in the references by the discussion of responder liabilities. This relates to the study results in that AFD analysis as their problem related to different group's concerns about different potential losses. Phase II (Planning) was referenced by the OSHA inspector list identifying target goals. AFD planning identified the need for providing a similar regulatory listing of goals as part of the fire code. Phase III (Implementation) was identified in the references by the examples of the RTFC and CIMA. These groups, being formed by several companies, provide needed assistance to each other and cooperation with local fire departments. A similar cooperative, called the Centex ERT Forum, was formed by Austin high tech industry. Phase IV (Evaluation/Institutionalization) was identified in the references by the description of the Santa Barbara County incident investigation. The performance measures resulting from the AFD change allowed a proactive evaluation before such a reactive evaluation becomes necessary.

The results of this evaluative study identify some opportunities that AFD anticipated, and some that were not specifically considered. It is this student's opinion that the Austin Fire Department was able to anticipate enough items to effect an improvement in coordinating with private emergency response teams. Those items that weren't specifically anticipated by AFD, were defined enough to allow others to handle unfulfilled needs. The Phase I (Analysis) results indicate that AFD analyzed what it wants the high tech industry ERTs to be, and how the ERT corporate sponsors want AFD to cooperate. The Phase II (Planning) results indicate that AFD had a methodology for how the change in coordination could be allowed and evaluated. AFD did not however anticipate how corporate sponsors, the ERT

leaders, and the ERT members would interact in the long term to promote the professionalism of high tech industry ERT personnel. The Phase III (Implementation) results indicate that AFD was able to identify and communicate concerns to be used in measuring the change progress. However, AFD initially relayed on corporate sponsors to communicate the change to ERT members. Luckily, others provided a means for AFD to interact informally with ERT middle managers. The Phase IV (Evaluation/Institutionalization) results were identified for this paper but were not planned by AFD as part of the original change process. The study results do however provide performance measures for recognizing when the change is successful.

The organizational implications of the research study results are defined by the four phases of the CMM. They provide a template for any Fire Department to use in improving coordination with corporate emergency response teams when interaction has been scarce. The Phase I (Analysis) results describe the organizational influences between fire, corporate, and public entities that create the need for a successful method of coordinating hazmat response. The Phase II (Planning) results translate the need to have the ERT know when to ask the public fire department for help, into plans for providing the mechanisms that can fulfill this need. The Phase III (Implementation) results provide organizational methods such as drills and informal meetings with ERT middle managers, that will safeguard and facilitate execution of the change plan. The Phase IV (Evaluation/Institutionalization) results illustrate an organizational performance evaluation for continuously, systematically monitoring the change through response data and personnel survey.

RECOMMENDATIONS

The research findings from the first three phases of the CMM indicate recommendations for improving a similar change effort. Phase I (Analysis) was accomplished in a thorough manner during the change. Phase II (Planning) however identified a need for AFD to anticipate and assist in the formation of an industry cooperative group to help facilitate a cooperative change. Phase III (Implementation) identified the need for AFD to communicate a sense of urgency regarding future changes. It also identified an opportunity for AFD to provide symbolic change mechanisms such as ERT recognition's or awards. Phase IV (Evaluation/Institutionalization) was not originally provided for in the change, but this research paper now provides some benchmarks for evaluating change as high tech industry grows in Austin.

The nature of the problem studied in this research paper is related to the inability of the Austin Fire Department to influence high tech industry emergency response teams (ERT) in order to reduce hazmat team responses to their sites. The Change Management Model provides a useful template to evaluate previous changes and help ensure that a fire department can successfully influence their corporate customer. The purpose of this applied research project is to evaluate a change that was made in the way the Austin Fire Department coordinated with high tech industry ERT corporate sponsors, leaders, and members. In this case, AFD was able to accomplish a positive result with the help of others. It is recommended that the CMM be used at the beginning of the change process in the future in order to implement any additional means for improving coordination with ERT members.

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APPENDIX A - LOCAL REPORTING REQUIREMENTS

1991 UNIFORM FIRE CODE

ARTICLE 13 - EMERGENCY PROCEDURES

SECTION 13.202 - REPORTING OF EMERGENCIES AND FALSE ALARMS

13.202(a) General. Reporting of fires and hazardous materials releases shall be in accordance with Section 1302.

13.202(b) Reporting Emergencies. In the event a fire occurs or the discovery of a fire, smoke or unauthorized release of flammable or hazardous materials on any property occurs, the owner or occupant shall without delay report such condition to the fire department.

CITY OF AUSTIN, TEXAS
LOCAL AMENDMENTS TO THE
1991 UNIFORM FIRE CODE

PART 28. That UFC Section 13.202 is hereby amended to read as follows:

Sec. 13.202. Reporting Emergencies.

In the event a fire occurs or a discovery of a fire, explosion, deflagration, smoke or unauthorized release of flammable, toxic, or hazardous materials on any property occurs, the owner or occupant shall immediately report such conditions to the fire department.

EXCEPTION: Facilities complying with Sec. 80.109 by maintaining on-site emergency response teams (ERT) or industrial fire brigades that comply with the requirements of Occupational Safety and Health Administration (OSHA) regulations in 29 CFR 1910.120 and/or Subpart L may, upon completion of an audit (audits may be performed during annual inspections by the Fire Department) of compliance by the Chief and contingent on continued ERT/fire brigade compliance, develop site-specific procedures for determining reporting requirements for spills based on facility staffing and qualifications. Guidance is published in the Fire Protection Criteria Manual to help assure equitable assessment of site procedures. Such procedures shall be submitted to the Chief for review and approval. Maintenance of the ERT and/or fire brigade shall be verified by a periodic audit during inspections by the Fire Department. This provision shall not be construed as waiver of a facility's or organization's reporting obligations under State or Federal regulations.

Failure to maintain and provide records of internal spill responses shall result in revocation of the facility's procedural approach to reporting.

CITY OF AUSTIN FIRE PROTECTION RULE

Uniform Fire Code (13-8-400), Reference Section 13.202

Facilities with on-site emergency response teams (ERT's) or fire brigades - compliant with the requirements of the U.S. Occupational Safety and Health Administration (OSHA) as promulgated in Title 29, Code of Federal Regulations, Part 1910.120 and/or Subpart L - may develop emergency reporting procedures based in part on ERT/Fire Brigade staffing, qualifications, and equipment. Such procedures shall be submitted to the Fire Department for review and approval and such facilities shall be audited by the Fire Department to verify readiness of the ERT/Fire Brigade.

The Fire Department review and audit shall address the following areas and issues.

1. The facility shall develop and submit procedures which clearly outline the conditions for reporting to the Austin Fire Department. These conditions shall include any situation which presents or could present a threat to the environment and any situation which results in an injury requiring medical attention or in death. The reporting procedure shall comply with the reporting requirements of State and/or Federal regulations. In addition, all fires (including those extinguished by a Fire Brigade) shall be reported to the Fire Department at the time of occurrence.

2. The facility shall make available to the Fire Department all records pertaining to the training and qualifications of the ERT/Fire Brigade. Personnel may be identified by employee number in medical and training records for the sake of privacy. Sufficient information shall be provided to demonstrate the scope and completeness of facility training and medical surveillance programs.

3. The facility shall provide the training curriculum for the ERT/Fire Brigade for evaluation by the Fire Department. Such information may be classified as "Confidential".

4. The facility shall provide the qualifications of instructors used in the ERT/Fire Brigade training program.

5. The facility shall make available to the Fire Department complete spill and release logs (including those not required to be required to be reported). Copies of requested records for specific responses shall be provided for Fire Department records. ERT/Fire Brigade logs shall include the information required by 29CR1910.120(c)(3) to be available prior to site entry (i.e. location and approximate size of the affected area, description of the response activity, duration of employee activity, hazardous substance name and physical state, and a list of mitigation and personal protective equipment used). Proprietary chemicals may be referred to by chemical class, and proprietary processes may be omitted. ERT/Fire Brigade personnel may be identified by employee number.

6. Annually, generally during scheduled inspections, the facility shall provide updated lists of mitigation and personal protective equipment provided and maintained for use during spill incidents.

7. The facility shall conduct drills of the ERT/Fire Brigade at least once every three months. At least once per year, the facility shall request the Austin Fire Department units participate in a drill. Personnel on a shift ERT/Fire Brigade shall be required to participate in at least one drill per year. Also refer to UFC 51.111(d) for semiconductor fabrication facilities. If the shift ERT/Fire Brigade has participated in an actual response within the previous three months, the response may be considered to fulfill the drill requirement if a post incident critique is held which covers written training objectives developed as a result of lessons learned.

8. In accordance with Section 2.108 of the Fire Code, the Austin Fire Department maintains its full authority concerning fires and other emergencies. Inappropriate actions by an ERT or Fire Brigade may result in denial, revocation, or revision of the Fire Department's approval of a facility's reporting procedure.

The Fire Department shall consider the level of training, equipment, and complexity of drills in reviewing reporting procedures. For example, to relax reporting requirements for acid spills, a facility shall demonstrate that the ERT/Fire Brigade has the training and equipment to safety mitigate spills involving the types and quantities of acids indicated in the procedure.

APPENDIX B - INDUSTRY RESPONDERS AND SURVEY POPULATION

Austin high tech industries and number of hazmat responders, reported on applications for AFD hazardous materials permitting.

Company Name	Number of Hazmat Personnel
Abbott Laboratories	47
Advanced Micro Devices	40
Air Products & Chemicals, Inc.	3
Applied Materials	59
Ashland Chemical, Inc.	4
Condea Vista	6
Fisher-Rosemont Systems, Inc.	16
Huntsman Research Lab	20
Motorola, Inc. - Oak Hill	20
Motorola, Inc. - Ed Bluestein	35
Raytheon TI Systems, Inc.	17
Sematech	48
3M Austin Center	19
3M Research Blvd.	19
Xetel Corporation	5
Samsung Austin Semiconductor	20
Tokyo Electron	4
TOTAL	382

Survey Population attending training .

COMPANY	**Total Number Trained**
Applied Materials	92
Ashland Chemical	17
Condea Vista	2
Cypress Semiconductor	10
IBM Multek	17
Motorola	179
Samsung	23
Sematech	56
Solectron	2
TOTAL	**398**

APPENDIX C - INFORMAL ERT MEMBER QUESTIONNAIRE

Austin Fire Department Questionnaire
"High Tech" Emergency Response Teams

Please fill out the following only if you work for a company that is located within the Austin City Limits.
Be sure to answer all questions to the best of your ability....do not leave any blank.
If you have filled out one of these before...you don't have to do it again.

1. Check the job area below that best describes your responsibilities at work.

Production
Facilities
Environmental, Health, Safety
Administration
Management

2. Circle how many years experience you have on an Emergency Response Team

0-2 years 2-4 years 4-6 years 6-8 years more than 8 years

Please circle your opinion concerning your Emergency Response Team.

3. Your ERT is proficient at utilizing the personal protective equipment, decontamination equipment, and other spill/release equipment provided to them.

Strongly Agree Agree Disagree Strongly Disagree

4. Your ERT is proficient at determining whether there is a risk to employees and the public, then taking the appropriate actions.

Strongly Agree Agree Disagree Strongly Disagree

5. Check the maximum quantity of acid, spilled outside of containment, that you believe your site's ERT has the resources and ability to control and clean-up (in less than three hours).

0-55 gallons
55-300 gallons
300-3000 gallons
more than 3000 gallons

6. Our company expects too much from our team in the event of a real emergency.

Strongly Agree Agree Disagree Strongly Disagree

Please circle your opinion concerning the Austin Fire Department.

7. AFD typically over-reacts when responding to hazardous material incidents at our site.

Strongly Agree Agree Disagree Strongly Disagree

8. AFD participation in our team's training and drills is not adequate.

Strongly Agree Agree Disagree Strongly Disagree

9. AFD is a partner to our team.

Strongly Agree Agree Disagree Strongly Disagree